September 2017

Improving Science Teacher Retention:

do National STEM Learning Network professional development courses keep science teachers in the classroom?

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Education Datalab

2017

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Foreword

A world-class science education can only be delivered by world-class teachers. We believe in the power of high-quality continuing professional development (CPD) to help teachers improve their practice. That is why Wellcome invests in Project ENTHUSE to help fund teachers and technicians to participate in CPD at the National STEM Learning Centre.

But effective teachers can only be effective if they stay in the profession. Unfortunately, there is some evidence that science teachers are more likely to leave teaching than non-science teachers. This exacerbates the ongoing national shortage of chemistry, physics and maths teachers with recruitment targets in these subjects continuing to be missed.[1]

We commissioned the research reported here with two aims: to develop a greater understanding of science teacher retention; and to test whether there is any link between subject specific CPD delivered by the National STEM Learning Network and likelihood to stay in the profession.

The research shows that science teachers are indeed more likely to leave the profession than similar non-science teachers – this is particularly true for newly qualified teachers (NQTs) and particularly NQTs with physics or engineering degrees. Much evidence has been gathered that shows the positive impact of CPD delivered by the National STEM Learning Network on science teaching and student outcomes. This research reveals an additional benefit of much improved teacher retention. This gives a good return on investing in CPD – that is, the teachers who have benefited from these courses stay in the profession for longer. But importantly, this powerful finding also suggests that if all science teachers accessed CPD then retention would significantly improve, and without it workforce shortages could have been a lot worse.

Most school leaders recognise that high quality CPD leads to more engaging and effective teaching and ultimately improves pupil outcomes. However, some school leaders may be concerned that CPD could lead teachers to seek jobs elsewhere. This research found no evidence of this risk – participation in National STEM Learning Network CPD has no impact on how likely teachers are to move schools.

We believe that all science teachers should regularly participate in high-quality, subject-specific CPD throughout their careers.

We urge all governors and school leaders to ensure that their science teachers regularly participate in high-quality CPD to improve teaching practice and teacher retention.

Funders and policy makers interested in improving STEM education should know that investment in high-quality CPD not only improves teaching in the classroom, it also keeps more experienced teachers in the profession.

[1] National Audit Office, Training New Teachers, 2016

Executive Summary

England has a severe shortage of science teachers (MAC, 2016), in part because scientists are more likely to leave the teaching profession than their peers (Worth & De Lazzari 2017). Improving retention is therefore an important focus for science education policy.

This report uses data from the School Workforce Census (SWC; 2010-2015) to investigate patterns and determinants of science teacher retention in state-funded secondary schools in England. In Part 1, we use data from the SWC to investigate whether science teachers are more likely to leave their school or the profession than non-science teachers and explore factors associated with their retention. This analysis then helps to inform our research design in Part 2, in which we link data on participants of continuing professional development (CPD) delivered by the National STEM Learning Network (NSLN) between 2010/11 and 2012/13 with SWC data to investigate whether teachers who had undertaken such CPD were more or less likely to remain at their school or in the profession.

Part 1: Science teacher retention

Are science teachers more likely to leave their school than non-science teachers? Controlling for a range of teacher demographic, career and school characteristics, we find that (see Page 26 for a note on interpreting odds):

- The odds of science teachers leaving their school within five years are 26% higher than for otherwise similar non-science teachers.
- To put this into context, the odds of a non-science teacher leaving their school within five years are around 1, meaning for every one teacher that does not leave, one does leave. Among otherwise similar science teachers, the odds of leaving are 26% higher, which equates to odds of around 1.3, meaning that for every one teacher that does not leave, 1.3 teachers do.[2]
- The odds of newly qualified science teachers (NQTs) leaving their first school within five years are 35% higher than otherwise similar non-science NQTs[3].
- To put this into context, the odds of a non-science NQT leaving their school within five years are around 1.8, meaning for every one teacher that does not leave, 1.8 do. Among otherwise similar science NQTs, the odds of leaving are 35% higher, which equates to odds of around 2.4, meaning that for every one that does not leave, 2.4 do.
- The odds of science NQTs with a physics or engineering degree leaving their first school within five years are 87% higher than similar non-science NQTs.

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[2] Please note that all the "For context" statements in this section are approximations intended to help those without a statistical background interpret the findings.
[3] In Part 1 of this report, NQT refers to those teachers who began teaching in 2010.

Are science teachers more likely to leave the profession altogether (i.e., leaving their school and not going to work in another state funded school in England)? Controlling for a range of teacher demographic, career and school characteristics, we find that:

- The odds of science teachers leaving the profession altogether within five years are 5% higher than for otherwise similar non-science teachers.
- To put this into context, the odds of a non-science teacher leaving the profession altogether within five years are around 0.5, meaning for every one teacher that does not leave, 0.5 do leave. Among otherwise similar science teachers, the odds of leaving are 5% higher, which equates to odds of 0.525, meaning that for every one teacher that does not leave, 0.525 teachers do leave.
- The increased risk of leaving the profession is concentrated among science teachers who do have a science degree, but not in physics/engineering, biology or chemistry. The odds of this sub-group (e.g. those with an oceanography or food science degree) leaving within five years are 12% higher than for non-science teachers.
- We also found statistically significant interactions between being a science teacher and being young (under 25) and inexperienced (less than two years). This means that being both a science teacher and being young/inexperienced makes you more likely to leave the profession, above and beyond having either of those characteristics in isolation. We did not find any statistically significant interactions between being a science teacher and gender or the deprivation of school intake.
- The odds of science NQTs leaving the profession within their first five years in the profession is 20% higher than for similar non-science NQTs.
- To put this in context, the odds of a non-science NQT leaving the profession altogether within five years are around 0.5, meaning for every one that does not leave, 0.5 do. Among otherwise similar science NQTs, the odds of leaving are 20% higher, which equates to odds of around 0.6, meaning that for every one NQT that does not leave, 0.6 do leave.
- The increased risk of science NQTs leaving the profession is concentrated among those with a physics/engineering degree. The odds of this sub-group leaving within their first five years are 29% higher than for non-science NQTs.

Given the relative shortage of science teachers, we might expect them to be paid more than non-science teachers. However, controlling for a range of variables including experience, we find that:

- Science teachers get slower pay rises than non-science teachers, reaching a salary difference of around £300 less after six years.
- Across all years of our data, science teachers have average pay around £110 lower than non-science teachers).

Part 2: Evaluating the impact of National STEM Learning Network (NSLN) on science teacher retention

Our analysis revealed the following about NSLN participants:

- Between 2010/11 and 2012/13, 83% of all secondary schools in England had at least one teacher attend a NSLN course, and 57% of secondary schools had teachers attend at least five days' worth of courses over this three-year period.
- Participants were drawn fairly evenly from across the distribution of deprivation of school - intake and from the different regions of England.
- In total, 25% of science teachers in England attended at least one course between 2010/11 and 2012/13. The participation rate was even higher for teachers with less than two years of experience on the job, at 32%.
- The majority of courses taken were general secondary and post-16 science courses (17,627), followed by physics (4,226), chemistry (2,288), biology (1,096) and enrichment/careers (716).
- The majority of courses lasted for 1 day (18,844), followed by less than one day (4,270), over three days (2,445) and 1-3 days (1,777).
- The majority of participants have attended one course (9,049) but a significant minority have attended five or more.

In terms of retaining teachers in their school, the impact evaluation showed that:

- Amongst all teachers who participated in NSLN courses, participation is associated with individual teachers being more likely to stay in the same school.
- However, in our most rigorous models,[4] these associations disappear, suggesting participation has no impact on retaining teachers in their school.

In terms of retaining teachers in the profession, the impact evaluation revealed that:

- The odds that an individual teacher stays in the profession the year after participating in an NSLN course are around 160% higher than similar non-participants. This estimate is fairly stable across all participants, those who participate in two or more days of courses and amongst recently-qualified teachers.
- To put this in context, the odds that a science teacher who does not participate in NSLN courses is still in the profession one year later is around 11, meaning for every one teacher that leaves, 11 do not leave. Among those who participate, the odds of remaining are 160% higher, which equates to odds of 29, meaning that for every one teacher that leaves, 29 teachers do not leave.

[4] See pp57-61

- This association is still visible two years after participation both for recently-qualified teachers (those who first participated within five years of receiving NQT status) and our full sample of teachers.
- Moreover, this association reappears in our most demanding models and when data is analysed at a departmental not just an individual level. More specifically, science departments see a 4 percentage point reduction in the proportion of their teachers leaving the profession in the two years after at least one of the department's teachers goes on an NSLN course.
- To put this in context, science departments who do not have any members of staff who have participated in NSLN courses have wastage of around 10% per annum. A 4 percentage *point* reduction would therefore reduce wastage to 6% per annum, which is a drop of two fifths. This reduction in wastage is therefore materially important in size.

Introduction: Science Teacher Retention

High teacher turnover damages pupil attainment (Ronfeldt et al 2012; Atteberry et al 2016). High turnover is particularly damaging in subjects such as the sciences where there are a shortage of teachers because school leaders generally have to expend more effort and resources to find a suitable replacement. Where none are available, research shows that school leaders tend to either lower recruitment standards, make increased use of temporary teachers or increase class sizes (Smithers and Robinson 2000), all of which have been linked to reduced pupil attainment (Mocetti 2012; Fredriksson et al 2013; Schanzenbach 2006).

Where teachers that are leaving a school are quitting the profession entirely, this causes additional damage to pupil attainment at the systemic level. Teachers quickly become more effective, in terms of their ability to improve attainment, during their first few years on the job (Papay & Kraft 2015; Wiswall 2013). Moreover, there is suggestive evidence that this is particularly the case for science teachers (Henry et al 2012). This means that when science teachers leave the profession and are replaced by newly qualified teachers pupil attainment will tend to fall as a result. Understanding how to improve retention is therefore important.

Carefully controlled, quantitative research has identified a wide range of factors that influence teacher turnover including:

- teacher and pupil demographic characteristics (Borman & Dowling 2008)
- school accountability (Clotfelter et al 2004; Feng et al 2010; Dizon-Ross 2014, Sims 2016)
- teacher pay (Imazeki 2005)
- the availability of high quality professional development (Allen et al 2017)
- working conditions within schools (Simon & Johnson 2015)

Working conditions are among the most important determinants of teacher retention (Simon & Johnson 2015; Sims forthcoming) and are arguably highly amenable to change by policy makers and school leaders. In particular, existing research consistently identifies the quality of leadership and the extent of collaborative teamwork between teachers as the most important features of school working environment (Boyd et al 2011; Ladd 2011; Marinell & Coca 2013; Sims forthcoming).[5] Improved professional development for teachers, the subject of Part 2 of this paper, is another important aspect of working conditions (Sims forthcoming).

There are a number of reasons to think that biology, chemistry and physics teachers' patterns of entry and exit from the profession are distinctive from other teachers. First, leaving rates are higher for science teachers (Ingersoll 2006; NAO 2016) even when compared with similar teachers,

[5] It's important note that, due to limitations of our data, we are not able to control for this explicitly. However, in later stages of our analysis our triple-difference approach enables us to account for the quality of working conditions.

working in similar schools (Kelly 2004). Second, while other subjects generally see teacher shortages reduce during economic downturns, shortages of science teachers persist between economic cycles (Smithers and Robinson 2008; Goldhaber et al 2014). This may reflect the fact that teachers with a STEM degree are the only group of teachers with an outside pay ratio greater than 1, that is, who earn more outside of teaching than inside (see

Table 1 below). Several evaluations have shown that increasing science teacher pay towards what science teachers could earn outside of the profession has a large positive effect on retention, at least in the short run[6] (Clotfelter et al 2008; Feng & Sass 2015; Bueno & Sass 2016). Third, science teachers are highly unusual in that they generally have to teach one or two subjects in which they do not have a degree (e.g., a chemist will be expected to teach chemistry, biology and physics). The requirement to teach multiple subjects is seen as undesirable by many science teachers, as indicated by the high numbers of physicists that choose to teach mathematics instead of mixed science (Smithers & Robinson 2008). In general, teachers who are given multiple subjects to teach are more likely to leave their school (Donaldson & Johnson 2010). The demands of teaching science may therefore explain some of the higher levels of turnover among science teachers.

Table 1: Comparing teacher and non-teacher median salary by degree subject

Outside Pay Ratio	Degree Subject	Median Salary of Teachers	Median Salary of Non-Teachers	Difference (for teachers)
>1	Physics	£31,600	£38,000	-£6,400
	Maths	£35,500	£40,000	-£4,500
	All Science	£32,000	£35,000	-£3,000
	Biology	£31,000	£32,600	-£1,600
< 1	English	£28,000	£25,300	£2,700
	MFL	£31,200	£27,700	£3,500
	History	£34,100	£29,400	£4,700
	P.E.	£33,100	£25,000	£8,100

Source: Migration Advisory Committee (2016). Note: Shows only selected subjects. Chemistry not shown due to small sample size. This should not be interpreted as causal evidence because differences in pay may be due to the type of people who choose to go into teaching, as well as being due to the job itself.

[6] These studies look at retention bonuses lasting between one and four years.

Aims of this research

This research has two aims. The first is to investigate the differences between the retention rates of science and non-science teachers in state schools in England. We begin by describing and comparing the characteristics, mobility and retention of science and non-science teachers. We then build a logistic regression model of teacher retention which controls for a rich set of teacher and school characteristics. We then add to this a variable which measures both whether or not somebody teaches sciences and which type of science degree they have, if they have one, as well as interactions between whether or not somebody teaches science and their age and experience. Fitting this model to the data allows us to characterise precisely how retention and turnover vary between science and non-science teachers. We also describe and model science teacher pay to investigate what role this might play in the retention patterns we observe.

The second aim of this research, which is informed by the findings from the first part, is to evaluate whether participation in National STEM Learning Network (NSLN) subject-specific continuing professional development (CPD) courses can improve teacher retention. NLSN was set up in 2005 with the aim of providing science teachers, technicians and other educators with subject-specific CPD. Most of the face-to-face training has been delivered through the National STEM Learning Centre at the University of York, working in partnership with nine regional, and subsequently 50 school-centred local partners.

Several components of the NSLN have been evaluated, including the Myscience programme (NFER 2014), the Primary Science Specialist Programmes (Kudenko 2015; Wellcome Trust 2015), the Bringing Cutting Edge Science to the Classroom Programme (Prime & Dunford 2016) and the Triple Science Support Programme (STEM Learning Ltd 2016). There have also been two evaluations of the overall impact of the national and regional continuing professional development (CPD) programmes on schools, including on teacher retention (Bryant & Parish 2015; Bryant & Dunford 2016). However, these evaluations have largely relied on participant's statements of intention to leave or stay, rather than actual retention rates. Moreover, they have not established an equivalent control group against which the impact on participants can be judged. Although high-quality CPD has been linked with improved teacher retention in other research (Allen et al 2017; Sims forthcoming), this remains an under-researched issue.

This research addresses this gap in the evidence-base by linking NSLN data to government data on teacher retention, using statistical matching to create a comparable control group. It also uses panel data techniques to control for a range of other differences which are not included in the data but could potentially be causing differences in outcomes between those who took part in NSLN CPD programmes and those who did not. By doing so it provides important information about the impact of NSLN programmes on teacher retention.

1. Data and Definitions

This research is based on data from the Department for Education's School Workforce Census (SWC). This is a large administrative dataset which contains demographic, employment, absence, curriculum and qualification data on teachers working in state schools in England. The advantage of using the SWC is its coverage: being a census, it includes data on almost all teachers in state-funded schools in England. The disadvantage of this dataset is that some parts of it have quite high levels of missing information. For example, around a third of teachers do not have a known degree subject. We try to make the extent of missing data clear at each stage of the analysis so that readers can judge how it may be affecting the results.

The SWC has been collected during the autumn term every year since 2010 meaning that, at the time of writing, there are six years of data available. Our analysis largely concentrates on the individuals who were working as teachers in 2010 because they have the longest period of continuous follow up data available. The data allows us to see when a teacher has left their school, because they do not reappear in that school in a subsequent year, and when they are no longer teaching in a state school in England, because they do not reappear in any school in the subsequent year. While we can observe date of qualification for those that entered teaching prior to 2010, allowing us to infer years of experience in teaching, we cannot observe whether teachers have taken a break from teaching since qualifying and then returned to the classroom prior to 2010, making this an imperfect measure.

Our data follows teachers across time, which allows us to build up a rich picture of how teachers move between schools and out of the profession. However, this sort of data does also have downsides. In particular, the teachers that show up in our data, but who began teaching prior to the first year the data was collected (2010), have a distinctive characteristic: they are still in the profession. Teachers who are more likely to leave the profession early on in their careers are therefore underrepresented in our data. In order to address this "survival bias" we present most stages of our analysis twice: once for all teachers in our data and once for those who joined the profession in 2010. The latter approach gives us a full cross-section of new teachers in the profession, albeit at the cost of reduced sample size.

Table 2 shows summary statistics for the dataset. The typical secondary school teacher is female (75%), White British (88%), just under 40 years old, qualified 13 years ago and has been at their current school for 7 years. We allocate all teachers to their main subject department based on where they do most of their teaching. The largest single standard department is humanities (19% of teachers) followed by English (17%) and then science (14%). The final panel of Table 2 shows the large size of the SWC, containing around half a million teachers in each year. Unfortunately, high levels of missing values mean we cannot report on counts and percentages of different degree types among teachers.

We use variables measuring teaching assignments to define a science teacher as anyone who, in any of the six available years of SWC, taught science for greater than or equal to half of their timetabled teaching hours, and spent at least one hour a week teaching science. This definition is designed to exclude those who do teach science but only for a small minority of their timetable. This leaves us with 31,006 science teachers in state schools in England in 2010.

Table 2: Summary statistics of teachers in the SWC

Demographics	Female	75%
	Asian	4%
	Black	2%
	Mixed Other	1.5%
	White British	88%
	White Other	5%
	Age	39.5
Career	Qualified	96%
	Years at Current School	6.7
	Years Since Qualified	13.3
Subject	D&T Department	5%
	English Department	17%
	Humanities Department	19%
	Languages Department	6%
	Maths Department	11%
	Science Department	14%
Sample Size	2010	485,411
	2011	482,989
	2012	488,752
	2013	492,956
	2014	499,527
	2015	498,731

Source: School Workforce Census. Note: Demographic, Career and Subject variables based on pooling all teachers across all years of data. Not all response categories are shown for a given variable, so responses may not sum to 100%.

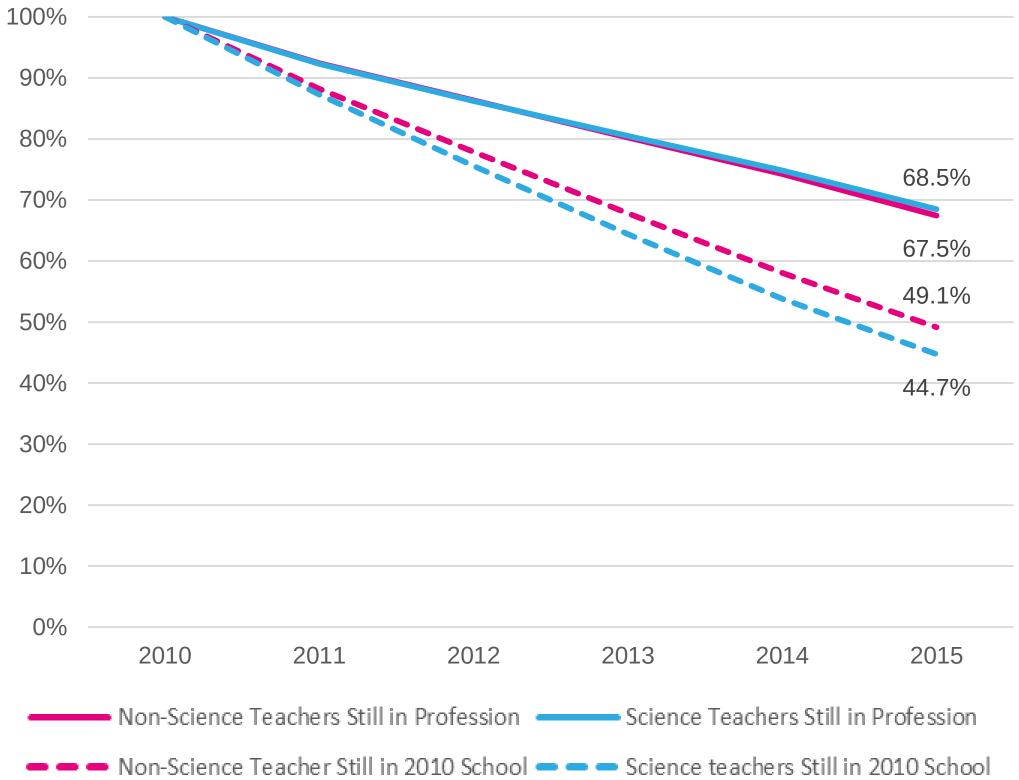
Because we are interested in the correlates of science teacher retention, we also define a science degree. The Department for Education maintains a list of all JACS codes (a standardised means of classifying degree subjects) which they consider to be a science academic degree. We use this definition to determine whether teachers in the SWC have a science degree (bachelor's, master's or doctorate). This definition of science includes the three core school sciences of biology, chemistry and physics, as well as other scientific disciplines such as geology and engineering, and more applied sciences such as ocean studies, food and drinks studies, nursing and sports science. It does not include psychology. In order to account for the wide range of sciences included, we report some of our results disaggregated by type of science degree: those with a physics/engineering degree, a chemistry degree or biology degree; those with any other science degree; and those with no science degree. Unfortunately, due to high levels of missing data in the SWC, we are not able to reliably categorise science teachers as being predominantly biology, chemistry or physics teachers.

Part 1: Science Teacher Retention

2. Descriptive Statistics on Retention

We begin our analysis by showing in Figure 1 the proportion of all 2010 teachers who remain in their 2010 school (dotted lines) and remain in the profession (solid line) in each subsequent year. Teachers display high levels of turnover (leaving their school) with more than half of all 2010 teachers having left their 2010 school within six years. Science teachers (blue line) have higher rates of turnover than other teachers (pink line), with a 4.4 percentage point gap emerging by 2015. Teachers also have high levels of attrition (leaving the profession), with over 30% of all 2010 teachers having left by 2015. Science teachers have lower levels of attrition than other teachers after six years, though the difference is very small.

Figure 1: Turnover and attrition of all 2010 teachers

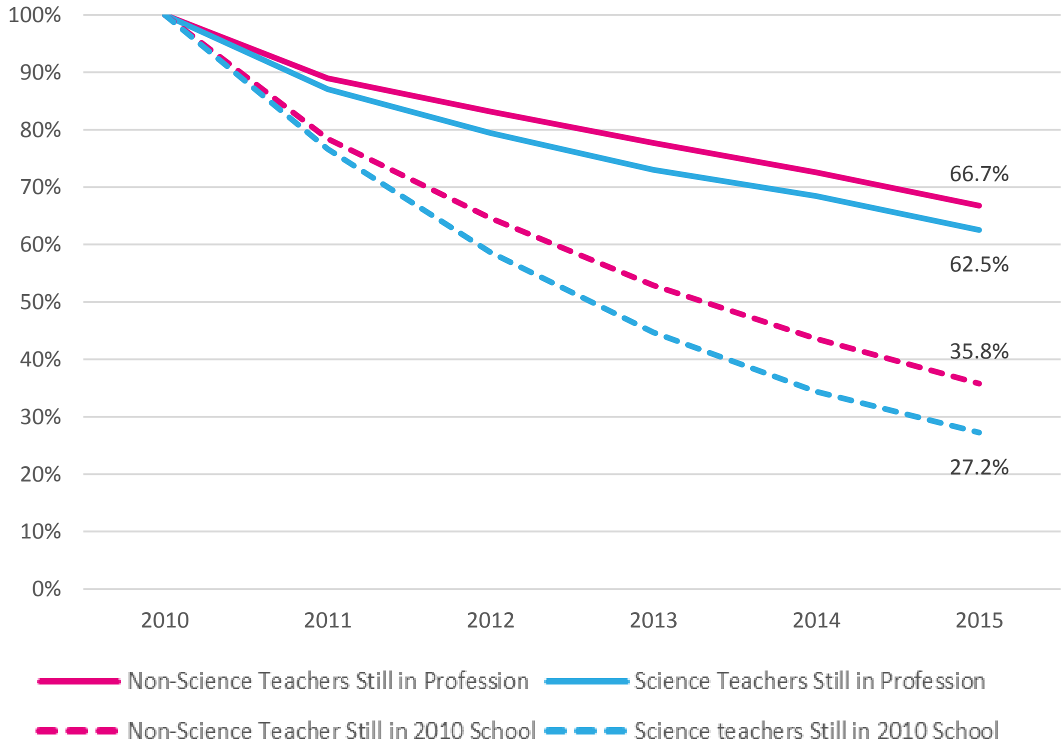


Source: School Workforce Census. Notes: Retention in the profession means still teaching in a state funded school in England. Cases with missing data excluded. N (number of teachers included in this graph) = 244,949.

Turnover and attrition of 2010 newly qualified teachers

Figure 2 shows the equivalent graph but just for those teachers who received their newly qualified teacher status in 2010 (we call this the 2010 NQT cohort). It shows that newly qualified teachers (NQTs) leave their 2010 schools at a faster rate than teachers as a whole. Science teachers are again more likely to leave their school than teachers of other subjects, with the margin growing to 8.6 percentage points after six years. The clearest difference with Figure 1 is that science NQTs are more likely to leave the profession than other NQTs, with the margin growing to 4.2 percentage points after six years. This difference is masked in Figure 1 by the large number of more experienced teachers, for whom there is not much difference.

Figure 2: Turnover and attrition of 2010 Newly Qualified Teachers



Source: School Workforce Census. Notes: NQT is anyone that is less than a year from qualification at time of 2010 census. Retention in the profession means still teaching in a state funded school in England. Cases with missing data excluded. N (number of teachers included in this graph) = 16,084.

Probability of leaving state-funded schools at a given point in time, 2010 NQTs

As well as looking at the rates of attrition over a period of time, we can also look at the risk of attrition at any given point in time. Figure 3 does this for the entire 2010 NQT cohort, including science teachers and non-science teachers, using smoothed hazard functions, which show the probability of a teacher leaving the profession at a given point in time, given that they are still in the profession at that point in time. Put another way, it shows the instantaneous or marginal risk of leaving the profession across the first years of a teachers' career.

The top left panel of Figure 3 shows the hazard function for all teachers. It is fairly flat but then rises in year 4, which means that teachers with four years of experience are at higher risk of leaving during this year than in any previous year.[7] This suggests that policy could be targeted at teachers during, or immediately before, this high risk period.

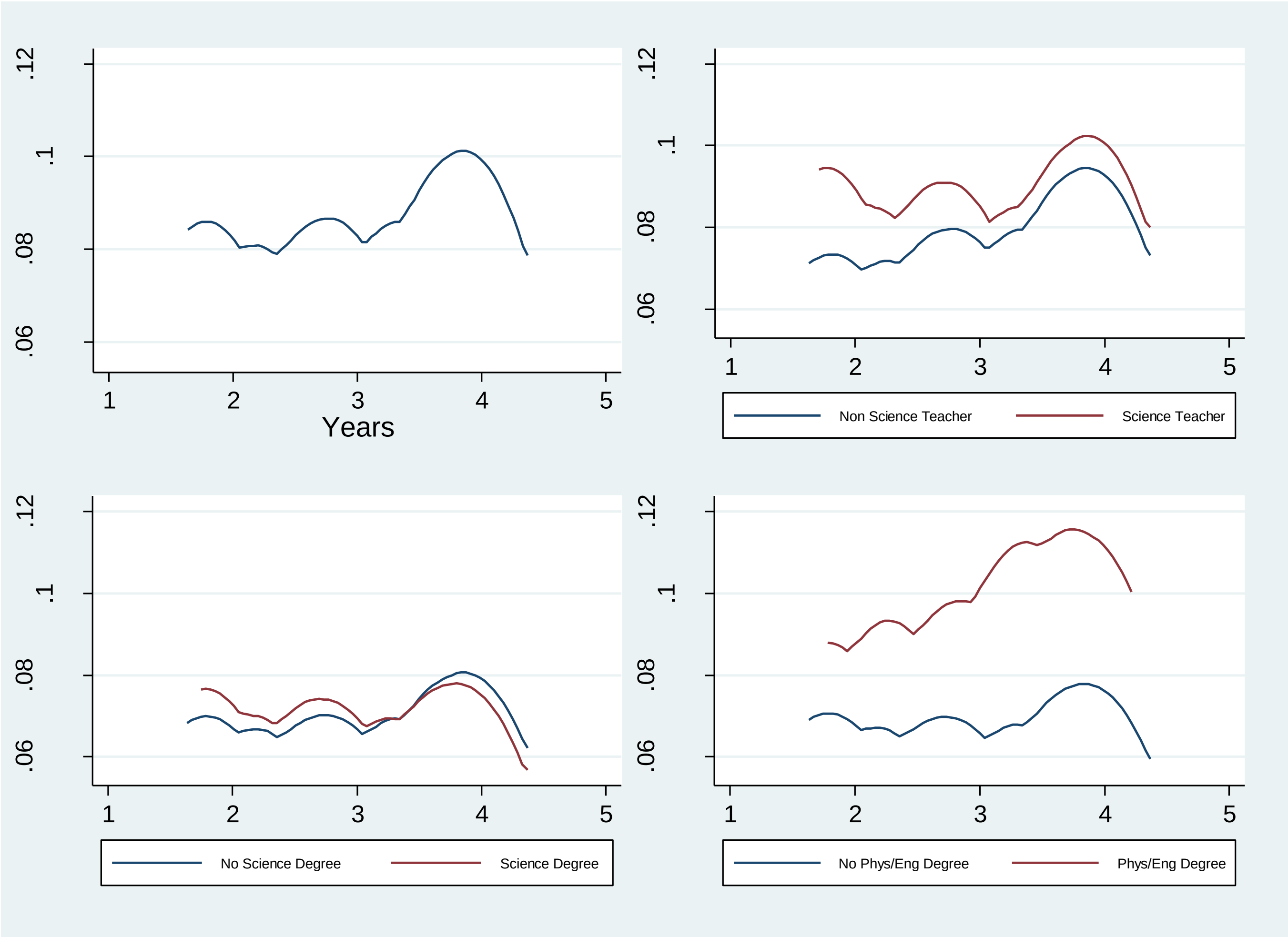
The top right panel plots two separate hazard functions, for science teachers (red) and non-science teachers (blue). Science teachers' risk of leaving is higher at each time point, though it appears to converge with that of non-science teachers as experience increases. This suggests that policy focused specifically on improving science teacher retention could be targeted at these high-risk first few years in the classroom.

The bottom left panel shows hazard functions for those with a science degree (red) and those without (blue). It should be noted that not all those with a science degree will be teaching science, and some who do not have a science degree may be teaching science. The two hazard functions are very similar.

The bottom right panel, which shows those with a physics/engineering degree versus those without, does however reveal clear differences in risk. Taken together, the bottom panels suggest that it is a physics/engineering degree that is correlated with increased risk of leaving the profession, rather than a science degree in general. Interestingly, the risk of leaving at any given time for those with a physics/engineering degree seems to diverge (move further away) from those without a physics/engineering degree between one and three years of experience, underlining further still how high-risk this group are.

[7] This reflects similar numbers of teachers leaving in the fourth year as in the first year, but over a smaller base of teachers still in the profession. This explains how the hazard function can be non-linear, while the rates of attrition (solid lines) in figure 2 are fairly linear.

Figure 3: Probability of leaving the profession at a given point in time, 2010 NQT cohort (hazard functions)



3. Modelling Teacher Retention

Comparing the turnover and attrition of science teachers and teachers of non-science subjects reveals interesting patterns. But it is possible that lower levels of retention are due to the demographic characteristics of those who become science teachers or acquire science degrees, rather than the fact that they are science teachers or have a science degree. To get a clearer handle on this, we model retention in order to see if the findings reported above hold when comparing science teachers with otherwise similar teachers of non-science subjects. Table 3 below shows the variables which we are able to hold constant in making these comparisons. For space reasons we do not report the coefficients and standard errors on these each time we report a model. However, we do report a full regression output in Appendix Table 16, for those who are interested in seeing the complete results. Briefly, it shows a number of already well-known findings, including that ethnic minority, inexperienced teachers in schools with disadvantaged, White British, low-attaining pupils are more likely to leave both the school and the profession.

Table 3: Control variables included in all retention models

Teacher Demographic Characteristics	Teacher Career Characteristics	School Characteristics
- Ethnic Minority - Sex - Age	- QTS - Permanent contract - Full time - Time since QTS - Time at school - Senior leadership role - Pay - Pay Squared	- Ofsted rating - Sixth form at school - Contextual value added at KS4 - % FSM pupils - No. of pupils - Inner London school - Outer London school - South East and East of England school

Note: QTS (Qualified Teaching Status); KS4 (Key Stage 4); FSM (Free School Meals)

Table 4 shows the associations between being a science teacher and the odds of a teacher either leaving the profession overall (top panel) or leaving their 2010 school (bottom panel). Each of the three columns is a separate regression using a different time point for measuring whether or not a teacher has left yet, with columns to the right looking at longer-term retention. In the top panel, the row of the table above the dotted line shows the change in the odds of leaving the profession associated with being a science teacher versus being a non-science teacher, holding constant everything in Table 3.

A Note on Odds

Because of the analytical techniques used in this report, we report many of our results as the change in the odds that an outcome (e.g., leaving the profession) occurs. Odds are not entirely intuitive, so we include a note here on how to interpret them.

Odds = $\frac{Probability\ something\ does\ happen}{Probability\ something\ does\ not}$

Let's take the example of the odds of remaining in the profession. The probability of remaining in teaching in two years' time in our matched sample is 86%. The probability of leaving is 14%. The odds of remaining are therefore $\frac{0.86}{0.14} = \sim 6$. In plain English, we would say that "for every one person that leaves, six people do not".

If we report the finding that, for example, participating in NSLN courses is associated with a 76% increase in odds of remaining, then the new odds would be 6 x 1.76 = ~10. In plain English, we would say that "for every one person that leaves, ten people do not".

Odds are not the same as probabilities. To see how, notice that the *probability* of flipping a heads on a fair coin is 0.5 but the *odds* of flipping a heads is $\frac{probability\ heads}{probability\ tail} = \frac{0.5}{0.5}$ = 1. Again, in plain English we would say that "for every one person that flips a heads, one would not".

The coefficient in the first column (0.0481) means that being a science teacher is associated with a 4.81% increase in the odds of leaving the profession one year later. However, the association is not statistically significant, as indicated by the lack of asterisks. This can also be seen from the standard error (in parentheses beneath the coefficient), which is large enough, relative to the coefficient, that the confidence interval includes zero (no association). Looking at the coefficients in column 2 and 3 however, we can see that being a science teacher (versus a non-science teacher) does have a statistically significant relationship with the odds of leaving the profession over a longer time period: increasing it by 7% three years later (2013) and by 5% five years later (2015).

Table 4: Modelling retention for all 2010 teachers

Compared to non-science teacher		By 2011	By 2013	By 2015
Left Profession	Science Teacher	0.0481	0.0700***	0.0490**
		(0.0286)	(0.0192)	(0.0163)
	Teaches Science & Has Phys/Eng Degree	0.133	0.0973	0.0286
		(0.0854)	(0.0583)	(0.0502)
	Teaches Science & Has Bio/Chem Degree	-0.0948	-0.0650	-0.0863**
		(0.0577)	(0.0375)	(0.0312)
	Teaches Science & Has Other Science Degree	0.112**	0.132***	0.116***
		(0.0344)	(0.0234)	(0.0201)
	Teaches Science & Has No Science Degree	-0.288*	-0.104	-0.0620
		(0.129)	(0.0798)	(0.0662)
Left School	Science Teacher	0.117***	0.212***	0.255***
		(0.0224)	(0.0154)	(0.0147)
	Teaches Science & Has Phys/Eng Degree	0.300***	0.430***	0.446***
		(0.0652)	(0.0459)	(0.0451)
	Teaches Science & Has Bio/Chem Degree	0.182***	0.212***	0.219***
		(0.0413)	(0.0285)	(0.0270)
	Teaches Science & Has Other Science Degree	0.0793**	0.187***	0.240***
		(0.0279)	(0.0192)	(0.0185)
	Teaches Science & Has No Science Degree	-0.0978	0.125*	0.274***
		(0.0945)	(0.0618)	(0.0593)

Source: School Workforce Census. Note: N = 160,633. Each column is a separate regression. The dotted lines also distinguish separate regressions within the two panels. Other = science degree that is not physics/eng, chemistry or biology; e.g. geology, ocean sciences. Demographic, Career and School variables from previous table also included in the model, but coefficients are not shown. The coefficients show change in odds associated with being in each category versus being a non-science teacher. * = statistically significant at 90%, ** = statistically significant at 95% and *** = statistically significant at 99%. Numbers in brackets are standard errors.

The rows beneath the dotted line in the top panel compare science teachers to non-science teachers according to the subject of their academic degree. Interestingly, this suggests that the increased risk of leaving the profession due to being a science teacher is largely due to the increased odds of leaving the profession associated with being a science teacher and having an "other" science degree versus being a non-science teacher. Science teachers with a physics/engineering, biology/chemistry, or no science degree are no more likely to leave the profession by 2015 than a non-science teacher. These findings are stable across all three of the time horizons. In summary, Figure 1 did not reveal any clear difference in raw attrition rates between science teachers and non-science teachers. However, once we compare otherwise similar teachers, being a science teacher with a science degree that is not a physics/engineering or chemistry/biology degree, is associated with an increased chance of leaving the profession.

The bottom panel of Table 4 repeats the layout of the top panel, but models the odds that a teacher leaves their 2010 school, whether for another school or to leave the profession. Being a science teacher, as opposed to a non-science teacher, is associated with a 12% increase in the odds of leaving their school after one year (2011), rising to a 26% increase in the odds of leaving their school five years later (by 2015). These are strong associations. Looking at the results disaggregated by degree subject (below the dotted line), it is clear that this holds for all types of science teachers. The strongest associations are with having a physics/engineering degree and an "other" science degree. Interestingly, while the top panel shows that science teachers with no science degree are no more likely to leave the profession, the bottom panel reveals they are more likely to leave their school. One plausible interpretation of this is that they move school in search of a teaching assignment more closely related to their degree subject. These results are largely consistent across the three time horizons and are consistent with the raw comparisons in Figure 2.

Our earlier analysis in Figure 1 and Figure 2 suggested that differential retention in the profession is restricted to early-career teachers. Table 5 therefore reproduces Table 4, using only the 2010 NQT cohort. This approach has the benefit of removing any survival bias from the estimates. That is, we are basing the estimates on teachers as they enter the profession, rather than looking at those who have stayed in it up to that point. It shows that being a science teacher, as opposed to a non-science teacher, has an even stronger association with increased risk of leaving the profession among new teachers, increasing the odds by 9% one year after qualification (by 2011, although this is not statistically significant), by 25% three years after qualification (by 2013) and by 20% five years after qualification (by 2015).

The rows below the dotted line again disaggregate science teachers by their degree subject. Among early career teachers, the increased odds of leaving the profession for science teachers appears to be driven largely by those with a physics/engineering degree and those with a biology/chemistry degree, though the association for the latter only reaches statistical significance by 2015.

The bottom panel of Table 5 repeats the same layout for models looking at whether teachers leave their school. It shows that new science teachers are far more likely to leave their original school than comparable non-science teachers: the odds of this happening by 2015 being 34% higher. This increased tendency to leave their school is concentrated among science teachers with a specific type of degree: the odds of a new physics teacher leaving their original school are 87% higher than those of a comparable non-science teacher.

For those with a specific interest in teachers with biology or chemistry degrees, we report results for those two degree subjects separately in Appendix Table 19 for all teachers and for 2010 NQTs.

Table 5: Modelling retention for the 2010 NQT cohort

Compared to non-science teacher		By 2011	By 2013	By 2015
Left Profession	Science Teacher	0.0903 (0.0815)	0.247*** (0.0592)	0.197*** (0.0535)
	Teaches Science & Has Phys/Eng Degree	0.178 (0.0957)	0.328*** (0.0706)	0.291*** (0.0)
	Teaches Science & Has Bio/Chem Degree	-0.0692 (0.270)	0.247 (0.180)	0.404* (0.160)
	Teaches Science & Has Other Science Degree	0.0366 (0.165)	0.0860 (0.121)	-0.0814 (0110)
	Teaches Science & Has No Science Degree	-0.649 (0.400)	-0.0834 (0.240)	-0.184 (0.213)
Left School	Science Teacher	0.0604 (0.0791)	0.232*** (0.0634)	0.346*** (0.0688)
	Teaches Science & Has Phys/Eng Degree	0.275 (0.198)	0.520** (0.163)	0.865*** (0.199)
	Teaches Science & Has Bio/Chem Degree	0.0735 (0.129)	0.347*** (0.105)	0.284* (0.113)
	Teaches Science & Has Other Science Degree	-0.806** (0.304)	0.126 (0.197)	0.263 (0.212)
	Teaches Science & Has No Science Degree	0.0604 (0.0791)	0.232*** (0.0634)	0.346*** (0.0688)

Source: School Workforce Census. Note: N = 11,328 – 11,513. Each column is a separate regression. The By 2011 column shows the difference in odds of leaving compared to non-science teachers by 2011, the By 2013 column shows the difference in odds of leaving by 2013, and so on. The dotted lines also distinguish separate regressions within the panel. Other = science degree that is not physics/engineering, chemistry or biology (e.g. geology, ocean sciences). Demographic, Career and School variables are also included in the model, but coefficients are not shown. The coefficients show change in odds associated with being in each category versus being a non-science teacher. * = statistically significant at 90%, ** = statistically significant at 95% and *** = statistically significant at 99%. Numbers in brackets are standard errors.

The interplay between years of experience, science teaching and retention patterns identified in Table 4 and Table 5 is interesting. Another way to look at this is to add interaction terms to our model which look at the joint effect of being both a science teacher and having a given amount of experience or age. The coefficient on these interactions terms can then be interpreted as the effect of being both a science teacher and having a certain level of experience, over and above the effects of being either of these things in isolation. Table 6 shows the coefficients for these interaction terms once they have been added to the model reported in Table 5. Table 6 is estimated using all teachers present in a school in 2010. The row shaded in grey is the reference category, which is the category that the others are being compared to. The table shows that being a science teacher and being in the first one or two years of their career has an additional positive association with leaving the profession, above and beyond the effect of having either one of these characteristics. This comparison controls for all of the other things listed in Table 3, including age.

Table 6: Modelling leaving the profession with experience interaction terms

		By 2011	By 2013	By 2015
Years of Experience Interacted with Teaching Science	One	0.184*	0.287***	0.238***
		(0.0920)	(0.0648)	(0.0574)
	Two	0.279**	0.128	0.135*
		(0.0991)	(0.0703)	(0.0615)
	Three	-0.0585	0.0864	0.0854
		(0.114)	(0.0755)	(0.0640)
	Four	0.250*	0.0596	0.0535
		(0.115)	(0.0794)	(0.0667)
	Five	0.0648	0.143	0.0454
		(0.132)	(0.0850)	(0.0709)
	Five to Thirty			
	More Than Thirty	0.0527	0.0103	0.00973
		(0.0810)	(0.0572)	(0.0583)

Source: School Workforce Census. Note: N = 160,633. Each column is a separate regression. Demographic, Career and School variables are also included in the model, but coefficients are not shown. The coefficients show change in odds associated with being in each category versus being a non-science teacher. * = statistically significant at 90%, ** = statistically significant at 95% and *** = statistically significant at 99%. Numbers in brackets are standard errors.

Table 7 repeats the layout of Table 6 but looks instead at interactions between being a science teacher and age. The table shows that being a science teacher and being young has an additional positive association with odds of leaving the profession, above and beyond the effect of having either one of these characteristics. This comparison controls for all of the other things listed in Table 3, including experience.

Table 7: Modelling leaving the profession with age interaction terms

		By 2011	By 2013	By 2015
Years of Age Interacted with Teaching Science	Under 25	0.118	0.237**	0.213**
		(0.108)	(0.0745)	(0.0651)
	25-30	0.0385	0.107*	0.135**
		(0.0778)	(0.0529)	(0.0441)
	30-45			
	45-50	-0.0509	0.0386	0.00551
		(0.0845)	(0.0518)	(0.0418)
	50-55	-0.0354	0.0446	0.180*
		(0.0882)	(0.0631)	(0.0697)
	55-60	-0.198	-0.223	-0.154
		(0.168)	(0.142)	(0.172)
	60-65	0.203	0.949	-0.506
		(0.678)	(0.830)	(0.744)
	More than 65	-0.0509	0.0386	0.00551
		(0.0845)	(0.0518)	(0.0418)

Source: School Workforce Census. Note: N = 160,633. Each column is a separate regression. Demographic, Career and School variables are also included in the model, but coefficients are not shown. The coefficients show change in odds associated with being in each category versus being a non-science teacher. * = statistically significant at 90%, ** = statistically significant at 95% and *** = statistically significant at 99%. Numbers in brackets are standard errors.

We looked for other interactions with gender and deprivation but found none. We also looked for interactions with region and found some heightened risk of science teachers leaving in London, but there were no clear patterns.

Taken together, the findings in Table 6 and Table 7 emphasise the heightened risks of attrition for science teachers, particularly during their early careers.

4. Modelling Science Teacher Pay

As discussed in the introduction, pay has been shown to play an important part in differential science teacher retention patterns overseas. In this section, we model teacher pay to see how remuneration compares between science teachers and non-science teachers in England, again controlling for everything in Table 3, including experience and contract type. The row above the dotted line in Table 8 compares science teacher pay to non-science teacher pay and shows that, over the five years since 2010, science teachers achieved pay rises that eventually yielded a salary that was almost £300 less than comparable non-science teachers. Teachers who leave the profession are of course not captured in later columns, which is reflected in the falling N as we move across the three pay rise columns. Each column is therefore comparing science teacher pay-rises with non-science teacher pay-rises among those still in the profession at that time.

The final column helps give a more rounded picture by comparing the average pay of all teachers in 2010, revealing that science teachers are paid around £110 per year less than comparable non-science teachers. Again, it is important to bear in mind when interpreting these findings that we are comparing teachers with similar levels of experience. It should also be noted that the teachers that are included in our estimates here are very different to the teachers that feature in our estimates of pay increases in the top panel, meaning it is difficult to compare the two results.[8]

The rows below the dotted line again compare science teachers with non-science teachers, but this time broken down by their degree. Interestingly, it shows that the reduced pay-rises are concentrated among those with a physics or engineering degree.

We conducted a similar analysis for the 2010 NQT cohort but no clear patterns were visible, possibly because the reduction in sample size meant that the confidence intervals were much larger. Alternatively, those early in their career tend to follow fairly standard pay movements up the increments on the main scale that are not affected by whether the teacher chooses to take on additional role responsibilities.

[8] The Annual Pay estimates in the final column look at all teachers in 2010, whereas the estimates in, for example, the Pay rise 5y column looks at only those teachers who were teaching in both 2010 and 2015. The very fact that they are still in teaching means they will likely have a distinctive set of characteristics. In addition, the pay rises that occur between 2010 and 2015 will be affected by the new pay flexibilities introduced by the government during this period. The Annual Pay estimates in the final column will reflect the old national pay scales.

Table 8: Modelling teacher pay for all teachers in the 2010 census

Compared to Non-Science Teacher	Pay rise 1y	Pay rise 3y	Pay rise 5y	Annual pay (2010-2015)
Science Teacher	-33.18	-229.0***	-298.5***	-110.0**
	(24.89)	(51.63)	(61.83)	(37.32)
N	140,526	118,538	97,293	160,633
Phys/Eng degree & teaches science	-54.55	-393.7*	-628.1***	-19.56
	(75.75)	(154.5)	(185.1)	(113.3)
Bio/Chem degree & teaches science	-24.43	-232.1*	-275.2*	156.9*
	(44.27)	(90.17)	(108.1)	(66.15)
Other science degree & teaches science	129.9**	-177.6	52.92	-232.1**
	(49.69)	(101.7)	(120.1)	(74.38)
Non-science degree & teaches science	-5.137	-337.1	-136.8	-36.90
	(99.81)	(203.0)	(243.1)	(150.1)
N	132,842	112,244	92,281	151,717

5. Summary and Discussion of Retention Analysis

The English school system is suffering from a shortage of appropriately-qualified teachers, particularly in science. This report set out to investigate what is distinctive about science teacher retention.

Looking at retention in the profession, we find that:

- Across all teachers in schools in 2010, those teaching science left the profession at the same rate as non-science teachers. Once we control for a range of other teacher demographic, teacher career and school characteristics however, we find that the odds of 2010 science teachers leaving the profession by 2015 are 5% higher than non-science teachers.
- The increased risk of leaving the profession for science teachers is concentrated among those who have a science degree that is not in one of the three core sciences of physics/engineering, biology or chemistry. The odds of this sub-group leaving in the first six years are 12% higher than for non-science teachers.
- Looking at 2010 NQTs, those teaching science leave the profession at a faster rate than non-science teachers, with the retention gap opening to 4.2 percentage points by 2015. Once we control for a range of other teacher demographic, teacher career and school characteristics, we find that the odds of newly-qualified science teachers leaving the profession by 2015 are 20% higher than non-science teachers.
- The increased risk of leaving the profession for science NQTs is concentrated among those with a physics/engineering degree. The odds of 2010 science NQTs leaving by 2015 are 29% higher than for non-science teachers.
- Being a science teacher and being either young (under 30) or inexperienced (less than two years since qualification) is associated with an increased risk of leaving the profession, over and above the risk associated with having either of these characteristics in isolation.

Looking at retention in school, we find that:

- Across all 2010 teachers, those teaching science left their 2010 school at a faster rate than non-science teachers, with the retention gap opening to 4.4 percentage points by 2015. Once we control for a range of other teacher demographic, teacher career and school characteristics, we find that the odds of science teachers leaving their 2010 school by 2015 are 26% higher than non-science teachers.
- Looking at 2010 NQTs, those teaching science leave their 2010 school at a faster rate than non-science teachers, with the retention gap opening to 8.6 percentage points by 2015. Once we control for a range of other teacher demographic, career and school characteristics, we find that the odds of newly-qualified 2010 science teachers leaving their school by 2015 are 35% higher than non-science teachers.
- The increased risk of science NQTs leaving their school is concentrated among those with a physics/engineering degree. The odds of this sub-group leaving within five years are a startling 87% higher than for non-science teachers.

Looking at pay, and controlling for a range of other teacher demographic, teacher career and school characteristics, we find that:

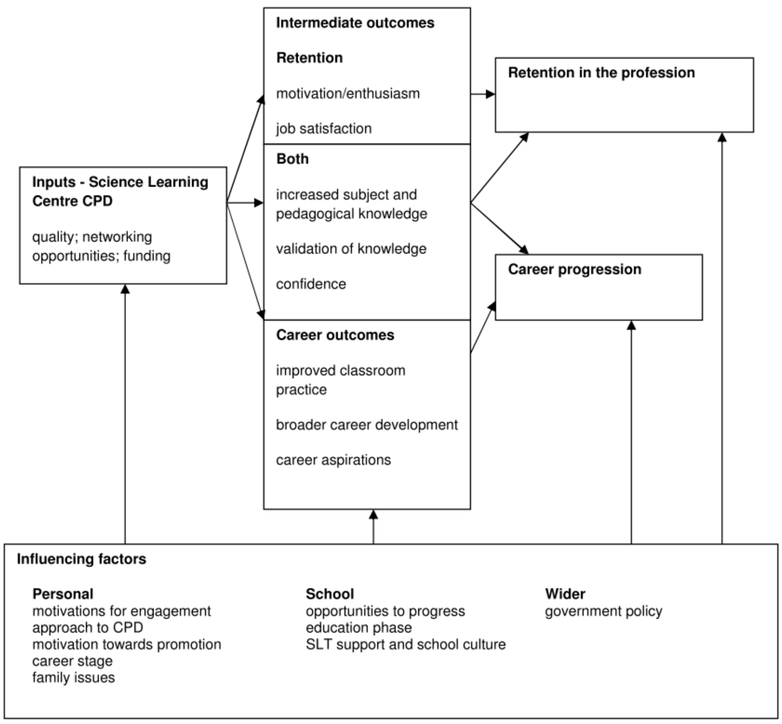
- Across all 2010 teachers, science teachers get slower pay rises than non-science teachers, resulting in a salary that is around £300 lower after the first six years of their career. These lower pay rises seem to be concentrated among science teachers with a physics or engineering degree.
- Average science teacher annual pay is around £110 lower than non-science teacher pay. However these lower levels of annual pay seem to be concentrated among science teachers who do not have a physics/engineering, biology or chemistry degree.

Part 2: Does The National STEM Learning Network Improve Science Teacher Retention?

6. The National Stem Learning Network Programme

The NSLN was set up in 2005 with the aim of providing teachers, technicians and other educators with subject-specific CPD. The aim of the CPD programmes is to improve teachers' subject, pedagogical and career knowledge, their confidence and motivation, the quality of teaching and leadership and teacher retention and progression in the profession (NSLN 2015). The mechanisms by which NSLN courses are hypothesised to affect retention, developed through extensive interview and survey research with participants (Wolstenholme et al 2012), is shown in Figure 4 below. In the next three sections of the report we investigate whether NSLN courses improve teacher retention. In this section we begin by looking at the characteristics of NLSN course participants.

Figure 4: Model of impact of National Science Learning Network CPD on retention and career



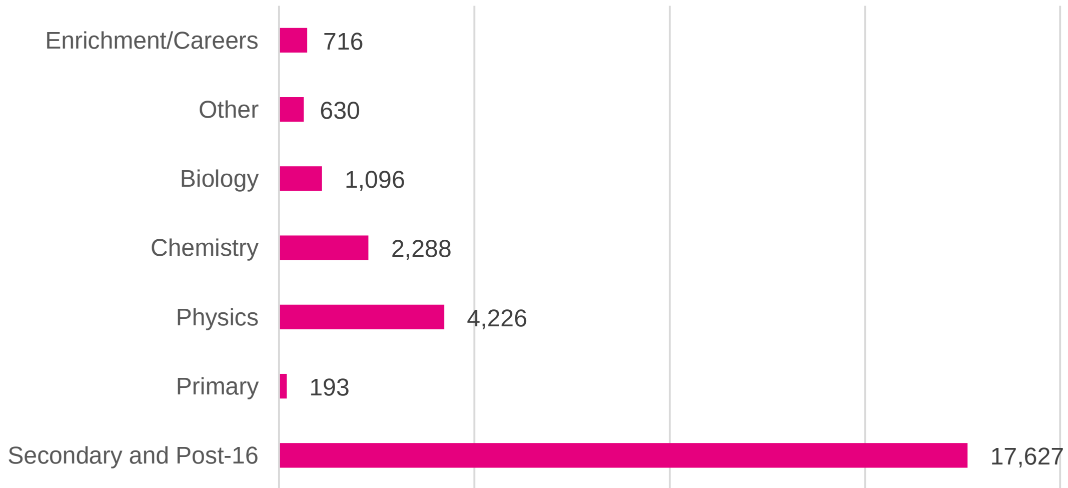
Source: Wolstenholme et al 2012 (SLT = Senior Leadership Team)

STEM Learning, which operates the NSLN, provided records of all individuals taking NSLN courses over the period 2010/11 to 2012/13. We identified those likely to be secondary school teachers using a combination of: (i) whether their job title suggests they might be one; and (ii) whether we can find them in a secondary school in one of the six years of the School Workforce Census. Table 9 shows that there were a small number of individuals taking courses whose job title suggested that they were *not* likely to be a secondary school teacher, but who were identified in a state-maintained secondary school so in all likelihood they were one and were treated as such. There were also around 1,000 NSLN course records a year where the participant's job description and school suggests they were a secondary school teacher and yet we cannot find them in the SWC. Sometimes this is because the matching fields – school name and teacher name – are only partially coded. In total, 3,016 records of the 26,776 (11%) could not be matched. This match failure means that our analysis understates the penetration of the programme across schools overall (each year between one sixth and one ninth of secondary teachers in the NSLN a records could not be linked to a record in the School Workforce Census).[9]

Table 9: Course records of likely secondary school teachers in the STEM Learning Centre database

		2010/11		2011/12		2012/13	
	Found in School Workforce Census?	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Job title category coded from STEM Learning database:	Secondary teacher	1,054	6,136	873	6,571	1,089	9,371
	Primary teacher		80		79		127
	Post-16		31		40		22
	Non-standard teacher		78		69		124
	Technician		249		237		264
	Teaching assistant		15		16		36
	Other non-teacher		10		12		18
	Not coded		55		44		76
	Total	7,708		7,941		11,127	

Figure 5: Subject and phase of CPD focus, by course taken 2010/11 to 2012/13

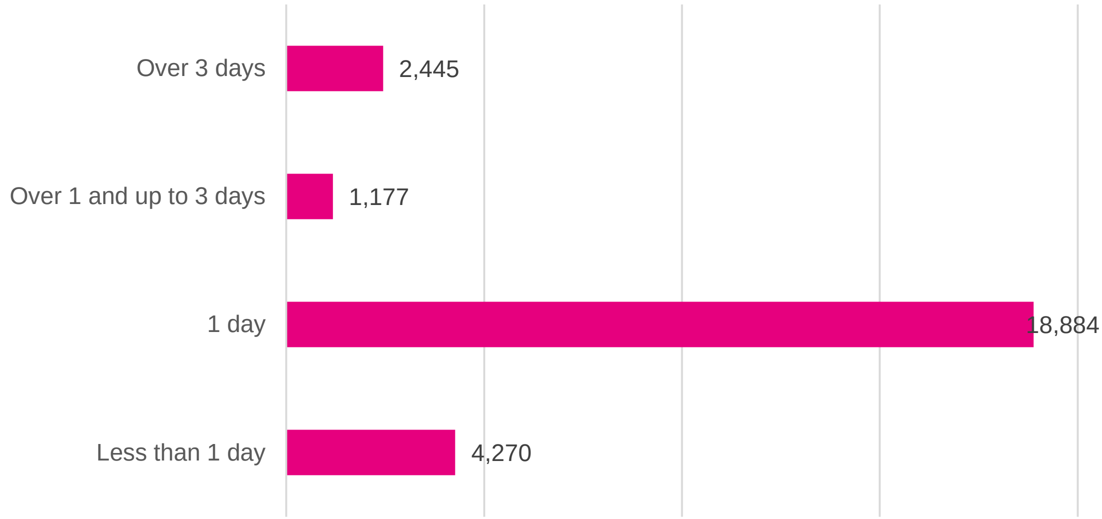


Note: sample restricted to participants believed to be secondary school teachers

[9] NB: teachers who only work in private schools would not appear in the School Workforce Census.

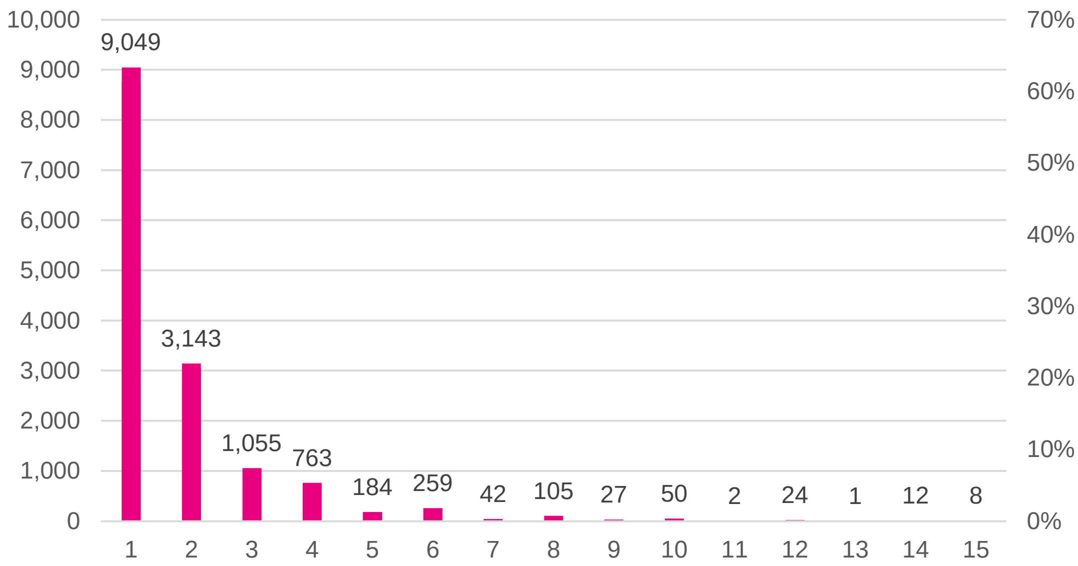
The majority (71%) of courses taken lasted just one day, as shown in Figure 5. Courses that last less than a day were provided by the regional networks. The vast majority (85%) of the long courses lasting longer than 3 days were provided by the National Centre in York.[10]

Figure 6: Length of course taken by secondary teachers between 2010/11 and 2012/13



The majority (61%) of teachers attended just one course over the three-year period, as shown in Figure 7.

Figure 7: Number of courses attended by a secondary teacher over the three-year period



[10] The finding that we have 193 secondary teachers taking primary science courses is likely due to a combination of middle school teachers classified as secondary teachers or basic misclassification of teachers and/or courses in the data.

Coverage of NSLN, 2010/11–2012/13

As shown in Table 10, between 2010/11 and 2012/13, 83% of all secondary schools in England had at least one teacher attend a STEM Learning course, and 57% of secondary schools had teachers attend at least five days' worth of courses over this three-year period. In total 25% of science teachers in England attended at least one course between 2010/11 and 2012/13. This rate of participation was higher (32%) for new teachers with less than two years of experience.

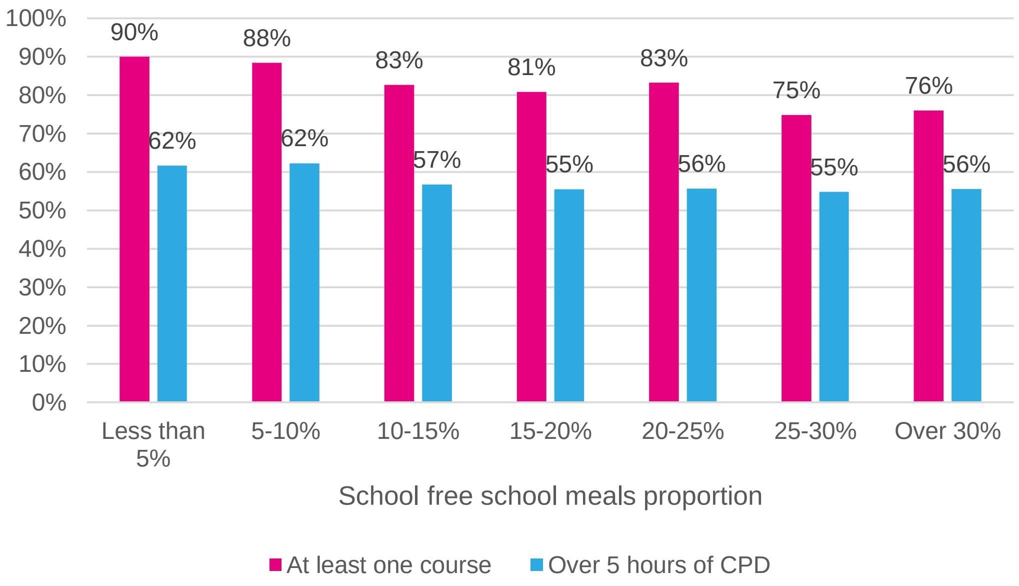
Table 10: Characteristics of those attending a course between 2010/11 and 2012/13

	Number	Percent
Male	14,269	24% of science teachers
Female	17,615	27% of science teachers
Science Teachers	8,130	25% of science teachers
Non-Science Teachers	10,214	1% of all non-science teachers
QTS	30,994	26% of science teachers with QTS
Non-QTS	890	21% of science teachers without QTS
Less than 2 years	4,192	32% of science teachers in experience range
2-5 years	5,552	30% of science teachers in experience range
5-10 years	7,373	28% of science teachers in experience range
Over 10 years	14,767	20% of science teachers in experience range

Notes: any time between 2010/11 and 2012/13. Percentages use 2010 secondary teachers as a base to avoid duplication.

Figure 8 shows that schools located in more affluent areas with a lower free school meals proportion had slightly greater take-up of NSLN courses. However, this social gradient in access to the programmes is not particularly stark.

Figure 8: Participation of teachers between 2010/11 and 2012/13 by percentage of their school's pupils eligible for free school meals



London is the region where schools participated the least in the STEM Learning courses, as shown in Table 11. This may be because teachers in London have easy access to a very wide range of professional development courses. The programme take-up was greatest in the South-West region over this period.

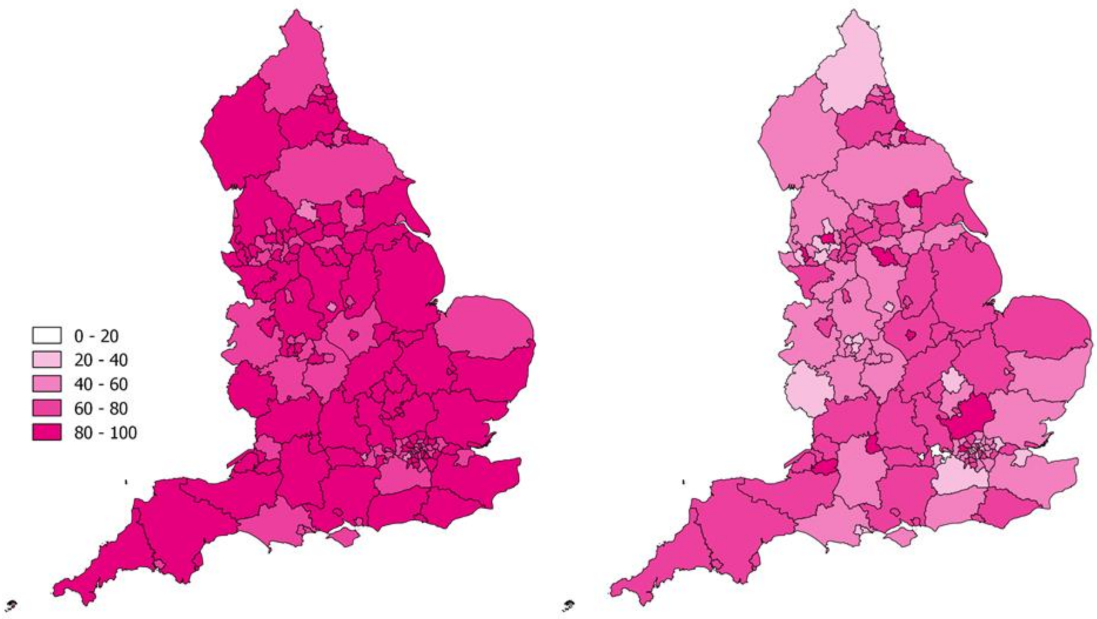
Table 11: School participation between 2010/11 and 2012/13, by region

	1+ course	5+ hours
East Midlands	82%	64%
East of England	85%	63%
London	79%	53%
North East	84%	58%
North West	84%	54%
South East	84%	55%
South West	86%	64%
West Midlands	80%	48%
Yorkshire and the Humber	83%	65%

The map on the left of Figure 9 shows that the programme has excellent reach across the country, with most schools in an area having at least one teacher attending a course. The lowest penetration over this period was in Derby where only 50% of schools had a teacher attending a course.

The right hand map on Figure 9 shows penetration of the programme for schools where teachers had in total attended at least 5 days training in this three-year period. There are five local authorities where penetration of secondary schools was only around one-in-five on this more demanding metric: Kensington and Chelsea, Reading, Windsor and Maidenhead, Warrington and Havering.

Figure 9: Percentage of schools participating in NSLN courses by local authority, classified as any teacher involvement (LHS) and at least 5 days between 2010/11 and 2012/13 of teacher involvement (RHS)



Note: we include any teacher involvement in a NSLN course in our classification but not technician or teaching assistant participation.

7. Does Participation in NSLN Improve Individual Science Teacher Retention?

In this section, we investigate whether an individual who participates in an NSLN course is more likely to still be working in the same school, or more likely to still be teaching in any school, in the following two years.

A very simple analysis would compare the retention rates of those that participate with those that do not participate in NSLN courses. If the retention of participants is higher, then this could be taken as evidence that the programme increases retention. As ever in policy evaluations however, the concern is that those who participate are less (or more) likely to leave than those who do not participate, irrespective of attending the course. For example, it is plausible that teachers who plan to stay in the profession in the long run are more likely to take part in the training than those who are unsure about remaining in teaching. This would be rational, since those who plan to stay in the profession will have more opportunities to make use of what they learned and may also be able to acquire a promotion more easily, having attended relevant training. If this is true, then comparing the retention of participants and non-participants would give a misleading picture of the effect of the programme, since participants would have higher retention due to being the *type of people who participate,* rather than as a result of participating.

In order to mitigate these concerns, we use a statistical technique called matching. Broadly speaking, this involves taking each NSLN participant and then finding a non-participant who looks as similar as possible to them. For example, if one of the participants is a 27 year-old, white-British female science teacher with a physics degree, who has six years of teaching experience, has been at their current school for three years, is employed on a full-time permanent contract on a salary of £32,000 per annum and works in an Ofsted 'Good' academy school in an urban area at which 30% of pupils qualify for free school meals and 26% have English as a second language, then we look for another teacher who is similar in all these respects, but did not participate on the programme. Once we have done this for every teacher who has participated in an NSLN programme, then we are left with a group of people who didn't participate in a NSLN course with very similar characteristics to those that did participate – known as a matched control group.[11] Because the two groups are very similar, this reduces the concern that any difference in retention rates between participants and non-participants is due to the *type of people* that participate. Any difference in retention rates is therefore more likely to be a result of the programme itself. Technical information on the matching is available in Appendix Table 18.

[11] Technically, we have a matched control group with very similar propensity scores, which are a measure of the likelihood of receiving the treatment (i.e., attending an NSLN course). This propensity score is modelled based on the variables in our dataset and identified to be of importance in Part 1 of this research.

It is important to note that we can only ensure our participant and control groups are similar in terms of the things that are recorded in our dataset. Fortunately, as illustrated in the example given above, our dataset contains a wide variety of variables measuring teacher demographic and career characteristics and characteristics of the teachers' school. For a full list see Appendix Table 17. Nevertheless, there are many things that are not measured in our dataset, such as individual motivation, and, to the extent that they affect whether or not a teacher participated in an NSLN course, this will reduce the accuracy of our estimate. The results in this section therefore cannot be interpreted as the causal effect of the programme. Having said that, they are informative about the relationship between participation and retention, holding a wide range of other factors constant. In the next section, we adopt a different, complementary approach which is able to avoid some of these concerns around whether our matched control group might be dissimilar in ways that we cannot observe.

We define a teacher as participating in the first year that they take part in a course. Some teachers only attend one half-day course in the first year in which they participate in NSLN activities, whereas others attend several days of courses in their first year. We therefore look at the effect of two different levels of "dosage" of the programme: any amount of participation ("Any Dose") and those who participate in more than two days of courses in the first year they participate ("High Dose"). We then test for differences in the retention (staying in the profession or in the schools) rates of participants and their matched control group using logistic regression. The results from this analysis can be seen in Table 12 below. The columns show different time horizons. The rows show the outcome variable (retention in school, or in profession[12]) and dosage categories. The percentage figures in each cell show the difference in odds of retention compared to the matched control group.

In this stage of the analysis we are looking at retention as an outcome. Increases are therefore a good thing. For example, the top left cell shows that those with any dose have odds of remaining in their school one year after first participating 48% higher than their matched control group. The number in brackets underneath it shows the standard error, which is a measure of uncertainty surrounding our estimates. The asterisks indicate whether this uncertainty is sufficiently small relative to the estimate that we can have confidence that the relationship is statistically significant.

[12] Technically, this measures retention in state-funded schools in England.

Table 12: Differences in odds of retention between NSLN course participants and matched control groups

		One Year After	Two Years After	N
Stay in School	Any Dose	+48%*** (0.1)	27%*** (0.07)	10,763
	High Dose	+40%** (0.23)	+5% (0.12)	1,889
Stay in Profession	Any Dose	+166%*** (0.23)	+76%*** (0.19)	11,428
	High Dose	+161%*** (0.57)	+74%*** (0.25)	2,108

Notes: Any use means > 0 days per person in first year of use between 2010 and 2013. Heavy use means > 2 days per person in first year of use between 2010 and 2013. N is for 1 year after. *** = significant at 99% level, ** = significant at 95% level, * = significant at 90% level. Standard errors are shown in parenthesise. A standard error of e.g. 0.23 relates to a +23% change in odds.

Table 12 reveals that the odds of any-dose course participants being retained in their school are 48% higher one year after first participating and 27% higher two years after first participating. High-dose participants are also more likely to stay in their schools after one year than their matched control group. However there is no statistically significant difference between whether high-dose users remain in their school two years after participation, and their matched control group.

In general, the results for retention in the profession, shown in the bottom panel of Table 12, reveal a strong positive association with retention. Both the any-dose and high-dose groups have odds of remaining in the teaching profession over 160% higher than (more than double) their matched comparison group. Although the association is smaller two years after participation, the odds for both dosage groups are still over 70% higher than in the matched comparison group.

In general, high-dosage users are no more likely to be retained either in their school or in the profession than any-dosage users. Indeed, high-dosage participation has a weaker association with retention in school after two years than any-dose participation. A plausible interpretation of this result is that heavy users are using the knowledge and credentials they gain from taking part to get a promotion in another school. This is consistent with the finding that high-dosage participation has a similar strength of association with retention *in the profession overall*.

Table 13 shows the results of a similar analysis using only data on recently-qualified teachers - those who first participated within five years of receiving NQT status. It shows that recently-qualified participants are more likely to stay in the same school than a matched control group. The odds of them staying in the profession overall are more than twice as high than their matched control group both one year after (163% higher) and two years after (117%) participation. The association with increased retention in profession is therefore more sustained for recently-qualified teachers than for teachers in general.

Table 13: Differences in retention rates between recently-qualified participants and a matched control group

	One Year After	Two Years After	N
Stay in School	+80%*** (0.06)	+41%*** (0.1)	4,219
Stay in Profession	+135%*** (0.29)	+191%*** (0.17)	4,550

Notes: Any use means > 0 days per person in first year in 2010-13. Heavy use means > 2 days per person in first year. N is for 1 year after. *** = significant at 99% level, ** = significant at 95% level, * = significant at 90% level. Standard errors are shown in parenthesise. A standard error of e.g. 0.23 relates to a +23% change in odds.

8. Does Participation in NSLN Improve Departmental Retention of Science Teachers?

As discussed, the analysis in the previous section is subject to concerns that the non-participants in our matched control group might be dissimilar to NSLN participants in ways that we cannot observe in our data. For example, participants might be more highly motivated in general, or have better lab facilitates, or more supportive senior leadership teams – all of which need to be ruled out in order to attribute differences in retention to the effect of NSLN participation. In this section we therefore adopt a different approach which is able to rule out a number of ways in which unobserved differences between participants and non-participants might be the reason for differences in retention. This increases the chance that any remaining differences are the result of participating in the programme, rather than reflecting the *type of people* who participate.

One way in which we can reduce the chances of unobserved differences between the two groups is to compare those who participated in 2010, say, to others who also participated, but not until a later date. Because both participate (eventually) they are more likely to be similar to each other in terms of their motivation, career plans and the supportiveness of the management in their departments. This is therefore an advance over the analysis in our previous section, in which participants may just have been more motivated than non-participants and therefore more likely to stay in their school or in teaching regardless of taking part in NLSN courses. In order to conduct this sort of analysis we have to aggregate our teacher-level data up to department level.[13] This means that instead of having information on, for example, age, experience and pay for each teacher, we instead look at the average age, experience and pay for each department in each school. Teachers are allocated to departments based on the subject that they spend most time teaching.

Another method for reducing the chances of unobserved differences affecting our estimates is to compare participating science departments to themselves, before and after the treatment. This technique, known as fixed effects, allows us to rule out any characteristics of the department which do not change over time being the real reason for differences in retention. The logic for this is simple: if something remains unchanged in a given science department, like the quality of the facilities, then it cannot be the reason for differences in retention in that department over time.[14] This is therefore an advance over our approach in section 7 where participants' higher levels of retention could potentially have been due to participants having better facilities than non-participants.

[13] Comparing the retention of individual participating teachers with individual future-participating teachers would not provide a meaningful comparison because, by definition, a future-participating teacher must be retained in the profession; otherwise they couldn't participate in future!

[14] We do not explicitly control for Qualified Teacher Status (QTS) route in our analysis. But, to the extent that it is stable within departments over the two years following participation, fixed effects will account for the use of e.g. Teach First trainees.

The quality of senior leadership is another unobserved difference which could potentially be causing the differences we observe between participants and non-participants. If decisions to participate are made by science department leaders then this may not be dealt with by comparing participating departments to future-participating departments. It could be the case, for example, that those who participate earlier happen to have better senior leadership teams and this is the real reason that early-participants have higher retention. In order to rule this out, we can use the changes in turnover in a non-science department in the same school as the participating science department to get a measure of the effect of school-level factors that have an effect across departments, such as senior leadership. We can then strip out this change in turnover, which would have happened in the science department even had it not participated in NSLN courses, in order to rule out any remaining differences in turnover being due to unobserved differences in leadership quality.

In order to implement these analyses, we drop all departments from our dataset except for science and English departments. We use English departments for our within-school comparison because they are also one of the main (English, science, maths) departments, and because, like science departments, they generally teach all pupils within a school, but, unlike maths, it is very rare for teachers to work in both science and English departments. We then match each participating science department to a similar future-participating science department. We then “stack” our data so that instead of having, for example, an average age of teachers in a given department in 2010, 2011, 2012 and so on, we instead have an average age of teachers in each department in the year before treatment, the year after and two years after. The results from this analysis can be seen in Table 14 below. The numbers in each cell no longer represent changes in odds of retention. Rather, they show the percentage point (pp) change in departmental turnover (leaving the department) or wastage (leaving the profession overall) after the department first participates. For context, the average science department turnover in our matched sample is 18%, meaning that a 2pp reduction in turnover in the average science department represents a reduction of 11.1%. The average wastage rate in our matched sample of science departments is 10%. A negative number means that participation is reducing turnover/wastage. For example, -3pp means turnover/wastage is being reduced by three percentage points. Again, the numbers in brackets are standard errors and the asterisks indicate whether the association is statistically significant. The Double Difference analysis in the top panel of the table shows the results from comparing the change (before and after participation) in retention in participating science departments, with the change in retention in future-participating science departments. The Triple Difference analysis in the bottom panel does the same, while also stripping out the change in retention in English departments within the same school as the participating science department. Because we are able to control for both the wide range of variables recorded in our dataset and a wide range of variables which are not recorded in our dataset such as teacher motivation and quality of the senior leadership team, we are able to get closer to a causal estimate of the programme using this approach.

Results

The results from the double difference analysis (Table 14) reveal no statistically significant effects of the programme on either turnover or wastage one year after a department first participates. Two years after first participation however, there is a two percentage point reduction in departmental turnover (statistically significant at the 90% level) and a three percentage point reduction in wastage (statistically significant at the 99% level).

Table 14: Estimates of the effect of NSLN course participation on departmental retention

		One Year After	Two Years After	N
Double Difference	Turnover	0pp	-2pp*	4,902
	Wastage	-1pp	-3pp***	
Triple Difference	Turnover	+1pp	+2pp	4,902
	Wastage	-2pp**	-4pp***	

Notes: PP = percentage points. N is number of groups/departments. *** = significant at 99% level, ** = significant at 95% level, * = significant at 90% level.

The results from the double difference analysis reveal no statistically significant effects of the programme on either turnover or wastage one year after a department first participates. Two years after first participation however, there is a two percentage point reduction in departmental turnover (statistically significant at the 90% level) and a three percentage point reduction in wastage (statistically significant at the 99% level).

Looking at the results from the triple difference analysis, the estimates for turnover become positive but are no longer statistically significant. However the estimates for wastage one and two years after first participation get slightly stronger, making the one year after estimate statistically significant (at the 95% level).

The findings from Table 12, and Table 14 consistently show that participation in NLSN courses is associated with improved retention of teachers in the profession. Although it is difficult to identify causal effects in the absence of a randomized controlled trial, the findings from the double and triple difference analysis in Table 14 suggest that the increases in retention in the profession in this group are due to participation in the programme, rather than due to the characteristics of the people who tend to participate in the programme.

9. Summary of NSLN Evaluation

This analysis set out to evaluate the impact of participating in NSLN courses on teacher retention. It has revealed the following about NSLN participants:

- Participating teachers during the period 2010/11-2012/13 represented 25% of all science teachers in England, and 32% of teachers in their first two years of teaching.
- The majority of courses are general secondary and post-16 science courses (17,627), followed by physics (4,226), Chemistry (2,288), Biology (1,096) and enrichment/careers (716).
- The majority of courses last for 1 day (18,844), followed by less than one day (4,270), over three days (2,445) and 1-3 days (1,777).
- The majority of participants have attended one course (9,049) but a significant minority have attended five or more.
- Participants are drawn from right across the distribution of deprivation of school intake and are also drawn fairly equally from across the regions.

In terms of retention in school, it showed that:

- Any-dose (>0 days) participants are more likely to stay in the same school than similar non-participants.
- While high-dose (>2 days) participation is associated with increased retention in the same school one year after the programme, the association is no longer statistically significant two years after participation.
- The association between participation and retention for recently-qualified teachers is slightly smaller than for all teachers one year after, but larger two years after.
- In our most rigorous models we do not find any associations between participation and retention in school.

In terms of retention in the profession, the impact evaluation revealed that:

- The odds that a participant stays in the profession the year after NSLN CPD are around 160% higher than for similar non-participants. This estimate is fairly stable across any-dose, high-dose and recently-qualified teachers.
- This association is still visible two years after participation both for recently-qualified teachers and our full sample of teachers.
- Moreover, this association reappears in our most demanding double-difference and triple-difference models that takes into account factors that are not included in the demographic and background measures examined. The finding of a link with retention in the profession is therefore robust.

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Appendix

Table 15: Degree subject and main teaching subject

Degree Subject	Teaches Non-Science	Teaches Science	Missing Data
Physics	490	2,101	188
Biology	445	4,083	351
Chemistry	344	3,885	378
Engineering	2,231	683	171
Sports Science	6,210	381	529
Other Science	5,522	6,312	953
Not known	82,456	11,852	23,593
Not science	82,311	1,709	7,771
Total	180,009	31,006	33,934

Table 16: Modelling Retention Using Teacher and School Characteristics

		Left Profession by 2015		Left School by 2015	
		Coeff.	Std Error	Coeff.	Std Error
Teacher Demographic Characteristics	Ethnic Minority	0.228***	(13.93)	0.0589***	(3.87)
	Male & Age < 25	-0.321***	(-7.23)	-0.171***	(-4.12)
	Male & Age 25-30	-0.261***	(-9.21)	-0.0208	(-0.84)
	Male & Age 30-45				
	Male & Age 45-55	0.740***	(32.03)	0.212***	(9.99)
	Male & Age 55-60	2.141***	(56.22)	1.474***	(37.74)
	Male & Age 60-65	2.572***	(30.30)	1.891***	(20.98)
	Male & Age > 65	2.452***	(7.19)	1.821***	(4.91)
	Female & Age < 25	-0.0742	(-1.47)	0.121**	(2.60)
	Female & Age 25-30	0.129***	(3.89)	0.0196	(0.68)
	Female & Age 30-45				
	Female & Age 45-55	-0.176***	(-5.95)	-0.0784**	(-2.86)
	Female & Age 55-60	-0.113*	(-2.44)	-0.00629	(-0.13)
	Female & Age 60-65	-0.126	(-1.09)	0.0124	(0.10)
	Female & Age > 65	-0.367	(-0.74)	-0.356	(-0.68)
Teacher Career Characteristics	1 Year of Experience	0.219***	(6.87)	0.322***	(10.43)
	2 Years of Experience	0.223***	(7.39)	0.244***	(8.54)
	3 Years of Experience	0.108***	(3.80)	0.131***	(5.03)
	4 Years of Experience	0.110***	(4.01)	0.161***	(6.59)
	5 Years of Experience	0.0757**	(2.78)	0.127***	(5.32)
	5-30 Years of Experience				
	>30 Years of Experience	0.944***	(41.89)	0.729***	(31.43)
	Years at school	-0.0624***	(-21.78)	-0.116***	(-44.06)
	Squared	0.00214***	(21.92)	0.00330***	(35.57)
	Head Teacher	0.442***	(5.16)	0.153*	(1.97)
	Deputy Head	0.0836	(1.88)	0.199***	(5.04)
	Assistant Head	-0.0581*	(-1.99)	0.00933	(0.37)
	Not SLT				
	Qualified Teacher Status	-0.0347	(-1.17)	0.0748*	(2.57)
	Permanent contract	-0.197***	(-8.24)	-0.409***	(-17.40)
	Working hours. 1 = FT	0.395***	(3.42)	0.420***	(4.27)
	Annual pay	-0.0000223***	(-8.33)	-0.00000988***	(-3.96)
	Pay squared	5.24e-11	(1.95)	1.89e-11	(0.76)

School Characteristics	No. pupils at school	-0.000151***	(-8.61)	-0.000137***	(-8.68)
	% pupils at school FSM	0.809***	(10.72)	0.903***	(12.92)
	% pupils ethnic minority	-0.260***	(-7.81)	-0.317***	(-10.49)
	Average prior attainment	-0.0683***	(-3.47)	-0.278***	(-15.63)
	Contextual Value Added	-0.00189***	(-5.72)	-0.00232***	(-7.72)
	Ofsted Outstanding				
	Ofsted Good	0.0618***	(3.73)	0.0541***	(3.71)
	Ofsted RI	0.188***	(10.20)	0.270***	(16.44)
	Ofsted Inadequate	0.238***	(6.49)	0.440***	(12.76)
	Sixthform	0.0586***	(4.05)	0.0375**	(2.86)
	Inner London	0.258***	(11.10)	0.369***	(17.51)
	Outer London	0.00425	(0.21)	0.0997***	(5.56)
	SE and East England	0.144***	(9.90)	0.256***	(19.54)
	Other Regions		(13.93)		(3.87)
	N	166,937		166,937	
	Pseudo R Squared	0.121		0.0824	

Source: School Workforce Census. Notes: Each column is a separate regression. Only five year time horizons shown. Variables included in the model but not shown: female dummy and department/subject dummies.

Table 17: Variables Used in the Matching

Teacher Demographic Characteristics	Teacher Career Characteristics	School Characteristics
- Teacher Gender - Teacher Ethnicity - Teacher Age	- Teacher Experience - Teacher Tenure - Teacher Contract Type - Teacher Hours (FTE) - Teacher Pay - Teacher Science Degree	- Student Gender Balance - Student FSM Mix - Student Ethnicity Mix - School Type - School Region - School Urban/Rural - School KS4 Attainment - School Prior Attainment - School Ofsted - School has Sixthform

Table 18: Comparing Characteristics of Participants and Matched Control Group

Variable	Means Treated	Means Control	% Bias	P Value
female	.53815	.55544	-3.5	0.049
2.ethnicity	.0427	.03466	4.1	0.017
3.ethnicity	.06755	.06231	2.1	0.226
4.ethnicity	.02993	.03399	-2.3	0.191
5.ethnicity	.01855	.01767	0.7	0.707
6.ethnicity	.01663	.01956	-2.2	0.214
age	36.03	35.671	3.7	0.034
experience	8.8835	8.6041	3.3	0.057
tenure	5.2061	5.1831	0.4	0.826
permanent	.9349	.93067	1.7	0.339
totfte	.99881	.99983	-4.1	0.013
fft_fixed_pay	35260	34572	6.7	0
female_all	.49788	.49858	-0.4	0.809
fsm_all	.15322	.15879	-4.6	0.01
eth_all	.2427	.24656	-1.4	0.433
2.instype	.12513	.12517	0	0.995
3.instype	.58593	.58052	1.1	0.533
4.instype	.06808	.07621	-3.2	0.075
2.reg	.12181	.1218	0	0.999
3.reg	.14631	.13839	2.2	0.197
4.reg	.05355	.05125	1	0.557
5.reg	.13003	.13313	-0.9	0.603
6.reg	.15173	.15538	-1	0.566
7.reg	.12093	.12153	-0.2	0.917
8.reg	.10361	.10183	0.6	0.74
9.reg	.08383	.09226	-3	0.092
2.urb	.50438	.49137	2.6	0.139
3.urb	.37732	.38211	-1	0.575
best8_ks4	342.88	341.98	3	0.087
prioratt_ks4	.02613	.00134	6.2	0
ofsted	2.0982	2.1152	-2.1	0.231
sixthform	.73031	.71999	2.3	0.189
acad_sci	.84932	.83504	4	0.026

Notes: This shows the results from the any-dosage teachers match.

Table 19: Modelling retention for science teachers with biology and chemistry degrees

	Degree	Move Within 5 Years	Leave Within 5 Years	N
All Teachers	Biology	+0.27***	-0.60	160,633
	Chemistry	+0.22***	-0.10**	
Recently-qualified	Biology	+0.26	-0.15	11,513
	Chemistry	+0.39	-0.01	

Source: School Workforce Census. Notes: Only five year time horizons shown. Each cell is comparing science teachers with either a chemistry or biology degree to teachers of a non-science subject.

Table 20: Number of teachers in November 2010 and proportions leaving the profession between 2010 and 2013, by years since qualified

	Non-science teachers		Science teachers		Teaching science with: Physics or engineering academic degree		Biology or chemistry academic degree		Another science academic degree		No science academic degree	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
<1 year	11,654	22%	2,206	27%	190	26%	467	24%	1,419	29%	130	21%
1-2 years	10,311	21%	1,956	23%	138	26%	464	17%	1,242	25%	112	24%
2-3 years	10,386	18%	1,937	19%	141	18%	508	18%	1,178	20%	110	19%
3-4 years	10,500	17%	1,845	18%	136	15%	494	15%	1,125	19%	90	13%
4-5 years	9,931	15%	1,715	17%	137	19%	430	16%	1,061	17%	87	17%
5-10 years	42,384	14%	7,338	14%	566	17%	1,971	12%	4,419	15%	382	9%
10-20 years	61,348	14%	11,004	14%	1,208	14%	3,032	12%	6,222	16%	542	13%
>30 years	23,495	47%	3,005	48%	268	46%	602	47%	2,000	49%	135	42%

Source: School Workforce Census; All secondary school teachers in November 2010 Census for whom we can identify their subjects taught at any point in a six-year panel of data. Note that retention rates are likely to be slightly understated in School Workforce Census due to data quality.

Table 21: Number of teachers in November 2010 and proportions leaving their school between 2010 and 2013, by years since qualified

	Non-science teachers		Science teachers		Teaching science with: Physics or engineering academic degree		Biology or chemistry academic degree		Another science academic degree		No science academic degree	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
<1 year	11,654	47%	2,206	55%	190	58%	467	58%	1,419	54%	130	52%
1-2 years	10,311	42%	1,956	48%	138	64%	464	45%	1,242	47%	112	51%
2-3 years	10,386	36%	1,937	42%	141	48%	508	43%	1,178	40%	110	45%
3-4 years	10,500	34%	1,845	39%	136	46%	494	39%	1,125	39%	90	34%
4-5 years	9,931	31%	1,715	38%	137	42%	430	40%	1,061	37%	87	35%
5-10 years	42,384	27%	7,338	31%	566	37%	1,971	29%	4,419	32%	382	30%
10-20 years	61,348	23%	11,004	26%	1,208	27%	3,032	24%	6,222	27%	542	26%
>30 years	23,495	50%	3,005	52%	268	52%	602	51%	2,000	53%	135	47%

Source: School Workforce Census; All secondary school teachers in November 2010 Census for whom we can identify their subjects taught at any point in a six-year panel of data. Note that move rates are likely to be slightly understated in School Workforce Census due to data quality.

Table 22: 25th percentile, median and 75th percentile of November 2010 pay distribution, by years since qualifying (£)

	Non-science teachers			Science teachers			Teaching science with: Physics or engineering academic degree			Teaching science with: Biology or chemistry academic degree			Teaching science with: Another science academic degree			Teaching science with: No science academic degree		
	p25	p50	p75	p25	p50	p75	p25	p50	p75	p25	p50	p75	p25	p50	p75	p25	p50	p75
<1 year	21,588	21,588	24,311	21,588	21,588	24,311	21,588	21,588	24,295	21,588	21,588	25,117	21,588	21,588	23,332	21,588	21,588	24,331
1-2 years	23,295	23,295	26,674	23,295	23,295	26,674	23,295	24,348	27,520	23,295	23,295	26,674	23,295	23,295	26,674	23,295	23,295	25,168
2-3 years	25,168	26,013	29,245	25,168	25,201	29,240	25,168	25,185	28,325	25,168	26,203	29,240	25,168	25,201	29,240	25,168	26,858	29,638
3-4 years	27,104	29,240	31,808	27,104	29,240	31,775	27,104	29,639	33,417	27,104	29,582	32,489	27,104	29,240	31,585	27,104	29,594	32,552
4-5 years	29,240	31,775	35,297	29,240	31,775	35,435	29,240	31,962	35,777	29,240	31,775	35,296	29,240	31,773	35,251	29,634	31,775	36,640
5-10 years	34,181	37,599	41,537	34,181	37,007	41,504	34,181	37,631	41,504	34,181	37,684	41,853	34,181	36,751	41,497	34,092	37,297	41,509
10-30 years	38,961	43,734	49,147	37,982	43,727	49,149	38,991	43,914	49,149	39,197	43,914	49,130	37,599	42,979	49,130	39,291	45,768	52,900
>30 years	36,756	42,953	49,223	36,756	42,828	49,179	36,788	43,990	52,323	36,756	43,990	50,476	36,756	42,318	48,693	36,789	42,952	52,900

Source: School Workforce Census; All secondary school teachers in November 2010 Census for whom we can identify their subjects taught at any point in a six-year panel of data. NB: Figures for early-career science and non-science teachers are very similar because, at the time, the vast majority of early-career teachers were paid in line with national pay scales.

Table 23: 25th percentile, median and 75th percentile pay rise achieved between November 2010 and 2013, by years since qualifying (£)

	Non-science teachers			Science teachers			Teaching science with: Physics or engineering academic degree			Biology or chemistry academic degree			Another science academic degree			No science academic degree		
	p25	**p50**	**p75**	**p25**	**p50**	**p75**	**p25**	**p50**	**p75**	**p25**	**p50**	**p75**	**p25**	**p50**	**p75**	**p25**	**p50**	**p75**
<1 year	4,511	6,149	8,349	5,515	6,158	8,149	5,763	6,229	8,306	5,563	6,215	8,392	5,264	6,120	7,989	4,796	5,807	7,854
1-2 years	5,175	6,649	8,840	5,036	6,299	8,519	4,764	6,238	8,583	5,575	6,367	8,386	4,768	6,283	8,480	5,433	6,700	9,009
2-3 years	4,686	6,700	8,932	4,678	6,700	8,813	5,108	6,700	8,573	4,658	6,700	8,443	4,447	6,700	8,918	4,421	6,387	7,934
3-4 years	3,702	5,788	8,130	3,743	5,595	8,130	4,038	5,403	8,350	3,174	5,671	8,032	3,913	5,595	8,154	3,233	4,981	7,573
4-5 years	2,558	5,115	7,676	2,519	5,250	7,811	2,327	4,901	7,396	2,758	5,283	7,576	2,382	5,283	7,901	1,587	4,365	7,307
5-10 years	342	2,399	5,051	309	2,051	4,676	216	1,703	4,321	342	2,326	4,637	251	1,932	4,708	0	2,459	4,884
10-30 years	-431.7	428	3,209	-618.7	394	3,070	-708.8	368	3,019	-656.4	387	2,955	-610	396.3	3,070	-54.5	602.8	3,209
>30 years	-282	372.3	3,038	-125	387.2	3,715	-827	352	783	-227.5	443.6	3,888	-1	394	3,749	-57.67	645.5	5,168

Source: School Workforce Census; All secondary school teachers in November 2010 Census for whom we can identify their subjects taught at any point in a six-year panel of data.

September 2017

Version 1.0

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